SHANGHAI MUNICIPAL COUNCIL

PUBLIC WORKS DEPARTMENT

INSTRUCTIONS
TO
INSPECTORS

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INSTRUCTIONS

TO

INSPECTORS

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CHAS. H. GODFREY, M.INST.C.E.
Commissioner of Public Works.
September, 1920.

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DEFINITIONS.

The following definitions give the sense in which the words defined are used in these Instructions to Inspectors :

Arris.—The sharp edge or angle formed by the meeting of two surfaces.

Ballast, to (Road).—To lay spalls in a road so as to give a firm foundation.

Bearers (Bridge).—The cross timbers resting on the uprights (piles), and on which the stringers are laid.

Benching.—The two sloping ledges in a manhole on which the man engaged on cleaning and/or inspection of the sewer stands.

Binding.—Material such as decomposed sand which, when mixed with water, forms a slurry and is spread on road metal to bind the chips together.

Birds-mouth.—A **V** shaped angle or notch cut along the edge of a piece of timber into which the next piece of timber fits.

Blinding.—Sand or gravel spread over the surface of a road to protect it until consolidated.

Bond.—The overlapping or binding together of different parts of a structure such as bricks, stone, timber, etc., etc.

Boning-rods.—**T** shaped pieces of wood used in setting out levels.

Braces (Bridge).—The diagonal timbers attached to the uprights (piles).

Camber.—The curve, from crown to sides, given to a road to prevent water standing thereon.

Camber board.—A board cut to the curve it is desired to give to the surface of a road and by means of which the camber can be set out on the ground.

Carriageway.—The portion of a road lying between the footpaths, available for vehicular traffic.

Centring.—Timber supports to the forms in concrete and reinforced concrete constructions.

Conservancy of Creeks.—Official care and preservation of the banks, bed, etc., of creeks with a view to maintaining the greatest possible flow of water throughout their lengths.

Decking (Bridge).—The planks laid on the finished structure forming the roadway.

Eccentric Centre to Road.—The crown of a road which is not exactly in the middle.

Fall.—A downward trend or slope given to a road surface or drainage channel to ensure that water does not stand thereon.

Feather-edge.—A very thin edge that is easily broken or bent; on a cutting tool such an edge as is broken or bent over.

Flushing.—To wash down with water. In creeks or sewers, the cleansing action caused by the flow of the water or of tides.

Footings.—The lower portion of a wall spread out so as to distribute the weight on its foundation.

Forms.—Moulds of wood used in concrete and reinforced concrete construction.

Gradient.—The rise or fall given to a road surface or sewer.

Grading a Road.—To level off the surface of a road.

Grout.—A mortar, fluid enough to be poured, used for filling in the joints of concrete work, brickwork, etc. and road metalling. Cement and water; lime, sand and water; decomposed sand and water are the most common forms of grout.

Gully.—A catch pit laid at the sides of roads to take surface or storm water.

Hames.—Curved pieces of metal in harness to which the traces are fastened.

Haunches.—The sides of the carriageway of a road.

Horizontal.—Parallel to the horizon, on a level, flat.

Homogeneous.—When used in concrete work means that the materials of which the concrete is composed, are thoroughly mixed, being evenly distributed throughout and tamped to avoid air holes.

Longitudinal.—Pertaining to longitude or length.

Manhole.—A square chamber inserted in roads at intervals and connected with the sewer below to give access for purposes of cleaning the same.

Metal to (Road).—To cover the surface of a road with stone chips to give a smooth and durable surface.

Mortise.—A cavity cut into a piece of timber, or other material to receive a correspondingly shaped tenon.

Piles.—Timber (or reinforced concrete piles) driven vertically into the ground and used for supports to bridges, foundations of buildings, bunding, etc.

Punning.—To consolidate earth or stones by ramming. (See tamping).

Roadway.—The full width of the road including roadside ditches, footpaths and the carriageway.

Scarify (a road).—To scratch or break up the surface of a road with the scarifier attached to a steam roller or by hand picking.

Screenings.—The residue left after road materials have been passed through a screen or sieve, and which may be re-used, the fine chips and dust being rejected.

Scouring.—In creeks or rivers, the cleansing and deepening action caused to the bed and banks by tides or by the flow of the water.

Sealing coat to an asphalt or tarred road.—The final coat of hot tar or asphaltum put on a road to prevent penetration of air or moisture.

Sheeting; Sheet Piles.—Thick boards or planks, wedge shaped at the lower end, driven into the ground to support the side of a trench. Sheet piles are also made in sheet steel with inter-locking edges.

Sight rails.—Pieces of timber set to required levels to give correct gradient to which sewers or drains are to be laid. They are spiked in position to poles driven into the ground on each side of the trench.

Slurry.—A mixture of decomposed sand and water used as a binding material for macadam roads.

Spalls.—Fragments of undressed stone as chipped off by a hammer or as the result of quarrying.

Squeegee.—A device with a handle and a cross piece at one end set with a strip of rubber, used for spreading liquid tar evenly over the surface of a road or for cleaning roads with a smooth surface.

Stringed line.—A string drawn taut between two points to give a level.

Stringers.—The horizontal timbers to which the decking of a bridge is attached.

Struts.—Lengths of timber placed traversly in a trench which is lined with sheeting which is supported by the walings on either side.

Tamping.—To drive down and consolidate earth, stone, etc., with successive blows of a tamper.

Vertical.—Perpendicular, upright.

Waling.—Strips of timber placed horizontally along sheeting to keep the boards or planks in position. Walings in turn are supported by struts.

INSTRUCTIONS TO INSPECTORS.

1.—BALLASTING AND METALLING ROADS.

After the road has been raised, the top of the mud should be formed to the camber which the finished carriageway is destined to take. The filling should then be rammed in order to thoroughly consolidate it and should any soft places be found, steps should be taken to rectify them. This can generally be effected by removing the wet mud that will as a rule be found in such places and replacing it by dry material.

The spalls for use in the foundation of the road should be deposited on the site with a view to avoiding the necessity for further handling as much as possible.

The spalls should be laid to the camber of the road and for a depth of about 10 ins. They should be laid along the channels first, so as to have the gangs on this part of the work about 10 ft. ahead of the gang laying the spalls in the centre of the road. The entire gang working on a full width of road should, therefore, take up a line approximating to a semicircle. The spalls when laid in this manner will form a more compact mass than when laid by a gang which works in a straight line across the road.

It is essential that each spall be laid on its largest base and that they be carefully packed so that no rocking takes place. The largest stones to be laid at the bottom of the foundation and the smaller ones used for packing in between.

Old screenings can be used with advantage, when the spalls have been laid, for working into the spaces that will always to a certain extent exist between the spalls.

After the spalls have been so laid they should be rammed so as to make the mass as compact and firm as possible. They should not be rolled.

On the top of this foundation a layer of 3 ins. of 1½ in. 2" chips to be laid and a sufficient quantity of decomposed sand to be added to form a binding in the manner stated in the instructions for Remetalling Roads, but without the addition of any ¼ in. chips. This layer to be thoroughly rolled until the depth is reduced from 3 ins. to 2 ins. Another layer of 1½ in. 2" chips, 3 ins. thick, to be then added, the camber being checked by the camber board, and reduced to 2 ins. in a similar manner, ¼ in. chips should be sprinkled on the surface on the completion of the rolling. The camber of the road to be again checked.

The rolling of these two layers should be done by a steam roller, used in the same way as in remetalling.

A longitudinal rise and fall should be given to the carriage-way of about 3 ins. in every 100 ft. so as to form a modified form of switchback along the length of the road which, whilst not being noticeable to the eye or to traffic, will materially assist the surface drainage of the road.

After the road has been opened to traffic it should be thoroughly watered. This has the effect of preventing the surface from breaking up.

2.—REMETALLING AND PATCHING ROADS.

Old metalling must first be scarified with the steam roller or picked by hand to a uniform depth, which will depend on the proportion of fine stuff found in the old metalling. If the proportion of fine stuff is large the road should be scarified or picked to a depth of 3 ins. ; if the proportion of fine stuff is small, a scarifying or picking to a depth of 2 ins. will do. It is of the utmost importance that the new coat of metal should not be laid on worn out material as the weak places in the old metalling will reappear in hollows on the surfaces of the new metalling. No lumps or inequalities to be left at bottom. Scarifying should be done when possible as it is preferable to hand picking.

It is essential that the whole of the existing crust of metalling be removed and passed through riddles and that the small material in the loosened surface be separated by screening with a ½ in. riddle. Replace in the road the stone that does not pass through the riddle and remove the remainder. Care should be taken not to increase the camber of the road.

Pass the roller over the old stone a few times. Add an adequate quantity of new 1½ in. stone. Roll until well consolidated. Fill any holes on the surface by brushing on ½ in. chips and roll again.

Mix Soochow sand with water to make a liquid grout. The grout must be passed through a sieve with ¼ in. mesh before being used. Further rolling should be done and the grout swept on to the road with bass brooms. The roller must not be taken away until the road is properly consolidated. A small quantity of ¼ in. chips should be sprinkled on the surface before opening the road to traffic. One cartload of Soochow sand should be used to every eight cartloads of 1½ in. chips, and one cartload of ¼ in. chips to every six cartloads of decomposed sand. Patching should be done in the same way and must be done in neat square patches. The whole of the work must be kept well flushed with water.

Begin steam rolling at the channels and work towards the crown of the road at the rate of about 3 ins. for every time the roller passes backwards. Drive slowly, and do not stop the roller at exactly the same spot every time. Holes made in the surface by the stone and binding material adhering to the roller wheels should be filled in with fresh stone, or the materials that come out of the holes should be replaced before the roller passes over the same place again. Remove immediately from the roller wheels any materials adhering to them.

Care must be taken to keep a proper camber on the road which should be about 1 in 36. Further details dealing with camber are contained in another section.

After a road has been remetalled it must be frequently inspected during a period of two or three weeks and any loose or soft spots attended to. The road should be well watered for a couple of weeks after completion, as this has the effect of preventing the surface from breaking up.

Care should be taken to avoid leaving the road on completion with a layer of Soochow sand on the surface. The surface should show 1½ in. stone in a uniform pattern.

Surplus material must be removed when the work is completed and not left on the side of the road in unsightly heaps.

3.—POT-HOLES IN ROADS AND THEIR REMEDY.

The following is a copy of a circular issued by the Acting County Surveyor of Oxfordshire to his staff, and it forms a good guide for procedure in reference to this class of work.

Unless a road is systematically coated pot-holes will show, and care should be taken at once to deal with these curses directly, or they will quickly get out of hand; sooner the hole is stopped the better for all.

Patching with "dry" material means waste and inconvenience; therefore it should be absolutely prohibited when dealing with pot-holes.

Observation must be made after rain, where holes or depressions appear and water stands. Each inspector must ascertain to what extent water stands, and must then, by scratching with a strong nail around the edge of the water puddle, mark how much excavation will be necessary to raise the depression up to the adjoining surface.

This mark must, directly the road is again dry, be marked deeper by a pick if the work of patching cannot be at once undertaken.

When the work of patching is commenced, each inspector must have a sufficient quantity of tarred material at hand to deal with the patch, and on no account must one patch be commenced before the other is finished and the road levelled. He must be provided with two sharp picks, a coarse and a fine brush, and a straightedge.

The top layer of material within the marked area must be thoroughly excavated to a depth of slightly more then 1½ ins, or a little deeper than the depression; the bottom must be left as rough by picking as possible. Every trace of loose or wet material must be swept out with the coarse and fine brushes, so that a rough, clean base is presented with the edges shaped to a sharp arris to the remaining road surface, and, if possible, slightly deeper on the outside edge than the centre of the patch.

The arris edge must then be treated with a layer of ½ in. and the centre with 1½ in. tarred material, every piece of the material being made to touch. Any over-plus of ½ in. must be swept towards the centre and every crevice filled up with ½ in. The whole must then be well and regularly rammed until perfectly level. This will at once be found by the application of the straightedge.

On no account must any feather-edge be left. The patch must be *in* the hole, and on no account be made to overlap, for if overlapping takes place, the edges will at once break away and fret.

Unless these directions are carefully followed a lump may result, which further work and excavation alone can remedy.

Pot-holes in a road surface are most serious and result in great expense if not dealt with. Every other kind of work, except that of attending to the draining and letting off surface water, should generally be allowed to stand over that the pot-holes may be stopped, one by one, as soon as they appear.

If will be found surprising how long careful patching can be carried out, and how useful the patches are later, in forming a key for the new coat when the surface can be patched no longer, and a coating of more permanent material has to be applied.

It has been said that roads should not be patched with tarred material, because a road is made bumpy by the patches standing up when the soft surrounding material wears away; but where this occurs it is too often the fault of the roadman or lack of proper supervision. Pot-holes are often 3 ins. deep, and when a patch is properly put in, even if it should be a ½ in. "up," one only gets a ½ in. bump instead of a 3 ins. one.

Much, however, depends on *proper* patching as to whether a bump is necessary at all.

4.—CHIP PAVED ROADS.

Chip paved roads are mostly used on less important thoroughfares where the traffic is more essentially Chinese in character. They possess the advantages over macadam roads of being economical in cost of construction and maintenance, the latter on account of their ability of being able to withstand more wear and tear on the surface than macadam roads can. On the other hand, they are less satisfactory than macadam roads on account of the noise caused by traffic passing over the hard surface and on account of the jolting caused to any form of vehicular traffic.

They are fairly easy to keep clean, but unless the joints between the stones are properly blinded they are apt to harbour filth.

The stones used for the work should be approximately 5 ins. by 3 ins. in size and no triangular or split stones should be used.

The foundation to consist of lime concrete, consolidated by rolling to a depth of 6 ins.

On the top of the foundation a bed of Ningpo sand or ashes 3 ins. in depth is laid in which to embed the stones.

It will be found advantageous to lay this bed about 20 ft. in advance.

The work should proceed up grade from the channel towards the crown, and with the sides in advance of the centre—so that the stones as laid will tend to crowd together and not apart. The stones to be set as closely and compactly together as possible and to break joint as far as possible.

After the stones are laid in position, the whole surface should be rammed with a heavy rammer until they become thoroughly set. If in ramming, any of the stones do not come to the correct camber, they must be taken out, re-set, and again rammed.

A thin layer of Ningpo sand is then spread over the surface and swept as much as possible into the joints, a small surplus being left to work its way in.

The camber for these roads should be the same as for macadam roads, viz. : 1 in 36, and the setting out should be carried out as described in the detailed instructions for camber.

5.—MUD ROADS.

These usually consist of roads in the more outlying parts of the Settlement where the land for the road has been acquired by the Council, but where it is considered that, for the time being, it is not necessary to construct a metalled road.

The mud is accordingly formed and graded sufficiently to allow the surface water to drain off as much as possible, and somade available for ordinary traffic during fine weather.

The road should be graded so as to have a camber of 1 in 24, and camber boards should be used from time to time to ascertain that the proper camber is being maintained.

It will usually be found necessary to rake and form these roads after each fall of heavy rain. In doing this the mud that has washed down into the channels and side ditches should be thrown back on to the crown or haunches.

When raking it should be seen that the coolies do not dig down more than 2 ins., unless the road has become very hard, when its condition should be reported on and when special instructions will be issued accordingly.

For raking under ordinary conditions Chinese rakes should be used, but, when the road requires to be properly loosened, mattocks should be used.

Footpaths should be formed on each side of the road and the edges of these should be kept trimmed to a good sharp line.

The footpaths should be made of standard width, when this is possible or, failing this, made 1 ft. out beyond the line of roadside trees.

As a general rule grass may be allowed to grow on the paths but it should be cut or trimmed from time to time.

It is important that the side ditches shall be kept clean and the longitudinal fall should be regularly checked by means of boning rods.

6.—TAR MACADAM AND TAR SURFACING.

Tar Macadam.—This form of road construction is used, generally speaking, on the more important roads where the traffic is somewhat heavy. Its high cost as compared with ordinary waterbound macadam prevents its general use.

Before laying tar macadam, it is important to see that the road foundation is in good order.

The thickness of the tar macadam when consolidated by rolling, should be from 3 ins. to 4 ins. according to the nature of the traffic. If it is found necessary to make the thickness more than 4 ins., the material should be applied in two coats.

The finished surface should have a camber of 1 in 40 or 1 in 48 according to width of carriageway.

The tar macadam should be levelled and spread on the site as soon as possible after its arrival from the depôt, and should then be rolled into a smooth surface.

A light steam roller is best suited for this and should be employed if available. Failing this a heavy hand roller should be used. It should be noted that less rolling is required than in the case of waterbound macadam.

After the road has been sufficiently rolled a coating of desiccated tar should be applied in the manner described under "Surfacing," and this should be blinded with coarse Ningpo sand on completion. It will frequently be found advisable to apply a second coating after the road has had traffic over it for about a month.

Tar macadamizing must not be carried out during frosty or wet weather.

Asphaltum *Tar Surfacing*.—Tar surfacing may be applied with great advantage to a waterbound macadam road where the traffic is not very heavy. It may also be used on roads with heavy traffic with some advantage. By tar surfacing, the life of the road is prolonged, a better surface results, and the dust nuisance is considerably abated.

Before so treating a road, it is necessary that the existing surface shall be in good condition, and remetalling or patching should be first carried out if necessary.

The ~~desiccated tar~~ should not be applied unless the surface to be treated is perfectly dry, and in any case not during frosty or wet weather.

No watering should be carried out one day before or two days after tarring any section of the road.

The surface should be swept perfectly clean by means of bass brooms just before the ~~tar~~ is applied, and barriers placed round to keep traffic off until the ~~tar~~ is cold.

Asphaltum

The ~~desiccated tar~~ should be heated to a temperature of 370° - 390° between ~~260°~~ and ~~280° F~~. before being spread on the road, and it is of the utmost importance that this rule shall be observed. If just below 260° F. the tar will not properly spread and adhere to the surface of the road, and if heated to above 280° F. the tar may be burnt and there is also the danger of it catching on fire by overflowing from the boiler.

~~The amount of desiccated tar required for surfacing~~ a waterbound macadam ~~road is about~~ 4½ gallons per 100 sq. ft. ~~for first treatment, and~~ about 3 gallons for the second coat.

On a road that is being surfaced for the first time it will be found best to spread the tar, after it has been ladled on to the road, by means of brushes, but on a road that is being treated for a second time and which already has in consequence an even surface, the spreading should be done by means of squeegees.

As soon as the tar has been spread, a blinding of coarse Ningpo sand should be used. Before being applied, this sand should be spread out close to the site of the work and allowed to become thoroughly dry. The surplus sand should be swept off the road after about two weeks.

In carrying out any tar work on roads every care must be taken that no damage is done to adjoining boundary walls, etc., by tar being allowed to spray on to them. Notices should also be posted warning all traffic that tarring is in progress.

7.—CAMBER OF ROADS.

"Camber" when applied to road construction, is the word used to indicate the curvature of the road from side to side. The objects of camber are to drain to the sides rain water which would otherwise soak into and injure the road or form puddles, which would destroy the road under the action of wheeled traffic. A properly cambered road allows of a certain amount of wear before surface drainage is seriously interfered with which would not be so with a flat road.

Diagrams giving the dimensions of standard camber boards required for roads of varying widths are published as a separate book.

In new roads where a 12 ft. strip only is metalled the macadam portion must be treated as a particular portion of a complete macadam carriageway, which may at any time be extended in width.

As the surface of the road is (approximately) a part of a circle, it is obvious that the road will be flatter near the apex than on the sides (haunches), anyone who is not sure of this has only to consider a semi-circle for a moment to see at a glance that this is so. It is therefore very important that the camber should be carefully set out and checked near the apex.

The camber may be set out with a spirit level and straight edge, working from level pegs which have previously been fixed, to indicate the level of the centre line of the road by the use of specially made camber boards or templates, the lower edge of which conforms to the curvature of the road while the top edge is level.

There are many reasons in practice which prevent roads being made with the proper camber as explained above; the chief of these are (1) the presence of tramway tracks, which may or may not be in the centre of the road; and (2) the necessity of having to construct roads where there is a considerable difference in the levels of the opposite kerbs and no possibility of altering them. With regard to tramways it is best to lay out the camber upon the assumption that the rail is the centre of the road.

Tramway tracks add considerably to the difficulty of making and maintaining proper camber.

The camber between the rails of a single track has been fixed at ¾ in., and that between two tracks as 1 in. On curves, however, the distance between tracks increases and it is necessary in some cases to give a camber of 1¼ ins.

With regard to cases in which there is considerable difference in the level of kerbs, it is obvious that if both branches of the road are to have the same camber, the apex cannot be in the centre but must be nearest the higher kerb.

Roads made of special material such as wood blocks, concrete or asphaltic concrete, and also very wide roads of macadam, will require special treatment and the following are the cambers to be adopted.

——	Carriageway	Carriageway
	Under 30 ft.	30 ft. and Over.
Mud roads	1 in 24	1 in 24
Macadam and chip-paved roads ...	1 in 30	1 in 36
Asphaltic Concrete	1 in 40	1 in 48

When an Inspector is in doubt as to the correct camber to be adopted for a road on account of the above conditions or for any other reason, he should refer the matter to the Assistant Engineer concerned.

8.—KERB AND CHANNEL.

This should be laid on a cement concrete foundation 4 ins. thick, composed of three parts 1½ in. chips, three parts ½ in. chips, two parts Ningpo sand to one part of Portland cement, thoroughly mixed according to the method described for cement concrete. The kerb should be laid horizontal at the same level as the footpath, but the channel should be laid so as to grade down towards the gullies. A fall of about 2 ins. should be given, the depth of the kerb at the top of the fall being made

3½ ins. and the gully 5½ ins. It is of great importance that the grading of the channel be made even, and to ensure this, three boning rods should be used, one fixed at the gully, one at the highest point in the channel, and the centre one being boned in between these two and so giving the correct level.

A stringed line should be used when laying the kerb so as to ensure that it is laid to a dead straight line, and every care should be taken that the top does not lean forward towards the channel.

At all corners granite kerb and channel must be used instead of ordinary concrete, as the latter is not suitable to withstand the chafing from the wheels of vehicles, that invariably occurs at such places.

9.—FOOTPATHS.

The general rule covering the widths of footpaths is as follows :—

Width of Road.	Width of Footpath.	
	Central and Northern Districts.	Western and Eastern Districts.
30 ft.	4 ft.	5 ft.
40 ,,	5 ,,	6 ,,
50 ,,	8 ,,	9 ,,

The following form special cases :—

Broadway	7 ft.	footpath.
Nanking Road, E. of Honan Road	6 ,,	,,
Nanking Road, W. of Honan Road	9 ,,	,,
North Szechuen Road	9 ,,	,,

Any cases not covered by the foregoing, should be referred to the office for instructions.

Cement Footpaths.—These should be laid with a fall of 1 in 36 on a chip-paved foundation, about 4 ins. deep, embedded on sand and firmly packed so as to ensure a good solid foundation. The top of the foundation should be 2 ins. below the finished level of the footpath.

The concrete should be laid in bays, this being done to prevent the cracking that would otherwise take place, owing to the changes in temperature.

Wooden strips 2 ins. deep by ¼ in. wide, should be used to form the divisions, the top of the strips being at the same level as the finished top of the footpath.

The concrete should then be placed in each alternate panel, the remaining panels being filled as soon as the cement in those first filled has set hard.

The concrete should consist of two layers, the bottom layer being 1½ ins. thick and composed of two parts Ningpo sand, two parts ½ in. chips to one part of Portland cement, mixed according to the directions given for cement concrete. This should be well rammed, and as soon as possible after this has been laid, the top layer ½ in. thick, should be laid. This should be composed of two parts of Ningpo sand and one part of Portland cement, thoroughly mixed according to directions.

The surface should be indented with the roller used for that purpose, and the surface should be protected from the sun by covering it with reed matting.

It should be kept constantly wet in order to delay the setting of the concrete so that the full strength of the latter may be developed. Traffic must not be allowed over the footpath for at least one week from the time of completion of the work.

When a cement footpath adjoins a new building, which it is anticipated may settle, and in doing so, tend to carry the back portion of the footpath with it, a space of 1 in. should be left between such building and the back of the footpath, so as to minimize the effect as much as possible.

Tarred Footpaths.—These should be laid with a fall of 1 in 24 on a broken brick foundation, 4 ins. deep thoroughly rolled and consolidated. The tar macadam should be laid at a depth of 3 ins. consolidated and thoroughly rolled until a uniform even surface is obtained.

A coating of desiccated tar should then be applied, the tar to be heated to a temperature between 260° F. and 280° F. Squeegees should be used to spread the tar and a blinding of coarse Ningpo sand should then be put on.

No tarring work of any description to be carried out during frosty or wet weather.

The footpath should be allowed not less than two days to set before traffic is allowed over it.

Gravel Footpaths.—These should have a fall of 1 in 24.

10.—REMOVAL OF SNOW.

The prompt removal of snow from the streets in the Settlement is of the greatest importance and the instructions given are as follows :—

The Commissioner of Police has given instructions that in the event of a heavy fall of snow occurring between 11 p.m. and 4 a.m. the Inspectors in Charge of Louza and Wayside Police Stations, will telephone to the Chief Assistant Engineer, who will get into communication with the Cleansing Inspectors and the Horse Bazaar, so that the removal of snow may take precedence over other work, except such as would cause danger or serious inconvenience to the public.

The Health Officer has been asked to see that as much of the work as possible is done by the garbage barrows.

The removal of snow should not be commenced until it has ceased falling.

Bridges, pontoons and main thorughfares should be cleared first. Gully gratings and channels should be cleared so that water may run freely. Street crossings should be cleared for convenience of foot traffic.

Snow that cannot be moved straight away should be piled near to, but not in, the channels on each side of the streets, and passages cut at intervals through the heaps for access to the houses. Snow may be dumped into the river or nearest creek or on any convenient waste ground.

The Tramway Company will send out five cars fitted with special snow ploughs and wire brushes. Two of these cars will run between Bubbling Well and the Rifle Range, two between The Bund and Yangtszepoo, and on the circular and Sinza Routes.

Double pay is usually issued to all labour engaged on the removal of snow, but this must not be entered on the Labour Sheets without reference to the office. If sanctioned, the extra day's pay for this work will be paid the day following.

11.—ASPHALTIC CONCRETE.

For a batch of 8.5 cub. ft. the following materials are required :—

(8.5 cub. ft. =1020 lbs.)

Chips passing 1 in. ring	25%=255.0 lbs.	92.5%=235.9 lbs.
,, $^{5}/_{8}$,,	35%=357.0 ,,	,, =330.2 ,,
Fine Ningpo sand ...	11%=112.2 ,,	,, =103.87 ,,
Coarse ,, ,, ...	11%=112.2 ,,	,, =103.87 ,,
¼ in. Chips ,, ...	10%=102.0 ,,	,, = 94.3 ,,
Portland Cement ...	8%= 81.6 ,,	,, = 75.5 ,,
	100%=102.0 lbs.	943.5 lbs.
Asphaltum=7½% of 102.0 lbs.=76.5 lbs.		76.5 ,,
	Total	1,020.0 lbs.

Description of Working of Plant.

The sand and stone are fed into the cold elevator and therefrom passed into the rotary dryer where they are heated to a temperature of 400° F. which expels all moisture, after going through the dryer they are taken up and passed through the screens from which they pass and fall into hoppers divided so as to receive the different sizes of stone and sand. During the screening any stone over size is automatically rejected. On the operator pulling over a lever, stone and sand in their proper proportions are discharged into the weighing machine, as soon as sufficient material for one batch has been discharged the operator shuts off the supply. This batch of stone and sand is then dropped, again by the working of a lever, into the steam jacketted mixer. The correct proportions of cement and asphaltum (the latter at a temperature of 280° F.) are then added to the materials, completing the necessary aggregates for the finished product. The whole after being throughly mixed for about 4 minutes is then ready for discharge into the motor truck waiting below. The heat of the mixture at the time of discharge into truck should be from 280 to 290° F. Inspectors should visit the plant at Sinza Road Depôt and make themselves acquainted with the process.

Method of laying Asphaltic Concrete, on old roads that have been graded.

The Asphaltic Concrete is spread on the site with rakes to a camber board constructed to give a camber of 1 in 40. When the mixture has been laid to the necessary thickness a hot roller is used to iron out the surface : the weight of the roller. should be about 500 lbs. per lineal foot. The rolling is continued from 20 to 30 minutes and is then left for a few hours. Any places which the roller cannot effectively compress, should be compacted with hot iron tampers. The new road is then painted with asphaltum at a temperature of 360 to 400° F., squeegees being employed for this purpose. Coarse Ningpo sand should now be used as a blinder and should be thoroughly rolled in with a steam roller. If the day is overcast and rain threatens, it is advisable not to wait until the afternoon, but to apply the sealing coat and blinder as soon as possible after work has been finished with the hot rollers. The sealing coat should not be applied unless the surface is clean and free from moisture. No work should be left over night without a sealing coat. Traffic may be allowed on the new roadway 12 hours after laying.

Temperature.—The temperature of the Asphaltic Concrete should be 240° F. or over when it arrives on a job. A mix of 220° may be laid for the full depth but the Inspector (or Foreman if the Inspector is away from the job at the time) should notify at once by telephone either Sinza Depôt or the Office when any temperature lower than 240° is reached. A mix of 200° may be spread out as a bottom layer. Any mix of lower temperature than 200° should be rejected.

The sealing coat should be of either J or K grade asphaltum and should be applied at a minimum temperature of 360°; the maximum temperature should not be more than 400°.

Rolling.—The first rolling after the raking out of the material should be from channel to crown. After slight compression, one roller should be kept moving up and down the road. During the earlier stages of rolling, the camber should be continually tried and great care should be taken that coolies do not walk on the soft mixture. Let the ropes be long enough to allow the roller full movement and on one side have them looped round the handle to keep same from scraping on the surface.

The fires in the rollers should always be kept bright. When it is necessary to rake the fires, the rollers should be pulled on to a plank. If this is not done an indentation will be made in the surface of the road owing to the heat of the roller.

Tools.—All tools employed in the work should be hot. While waiting for a new load to arrive, tools should be kept in a fire.

Joints.—When the last load for the day is being rolled, a rough joining edge should be left. This edge may be from

1 ft. 6 ins. to 2 ft. and tapering down from the finished work. Before joining with the next load this should be swept and painted with J grade Asphaltum.

When half a road has been already laid, the *vertical* edge should be painted with hot J grade Asphaltum and the new material which is being laid alongside, tamped hard with a hot tamper.

The joint with the channel should be kept high, this may be done by keeping a strip of wood ½ in. thick on the edge of the channel while the camber board is being drawn and during the earlier stages of rolling. When the strip is removed, the asphaltic concrete is rolled down over the edge.

The boundary in the centre of the road is made by a 3 ins, plank spiked in position.

Camber.—The camber should be frequently tried in order to avoid depressions, as filling in with half cold mixture does not tend to make a good road surface.

Eccentric centre.—Where a road widening is scheduled. the centre of the road is often eccentric. In order to arrive at the proper camber and the level of the channel on the narrow side of the road the following method may be employed :—

Measure from the centre line of the road to the kerb on the narrow side. Measure the same length back on the camber board which is being used on the full half of the road ; commencing the measurement from the thin or centre line end. The part which has just been measured is similar to the new camber board required for the narrow side.

When the new camber board is cut, put the centre line end at the centre line of the road and at the proper level, and level the top of the board. Then the lowest point of the board gives the proper level of the channel.

Thickness.—When laying asphaltic concrete, the first thickness should be 4 ins. which is rolled down to 3 ins.

12.—DRAINAGE.

General.—The drainage system of Shanghai deals at present only with storm and waste water. The system is so arranged that it is flushed by the tidal water, every main drain being subjected to such flush at spring tides and the majority to it twice daily throughout the year. In spite of the cleansing and scouring action that is thereby caused, it is essential that further steps be taken in the the laying of the drains, to ensure that they shall be kept automatically clean as far as possible. To ensure this the drains are, whenever possible, laid with such a gradient that the velocity of the fluid is sufficient to prevent the deposits of solid matter, which is thus carried to the outfall of the main sewer, the lines of the drains are so arranged that sharp bends; projections into the drains through faulty joints, bad connections, etc., are avoided. Failure to supervise and see that all of these points are attended to would result in a defective system.

Trench Work.—The nature of the trench will vary very considerably. For drains laid at a depth of 4 ft. or less, and where the soil is firm it will probably be found that no timbering at all need be used.

On the other hand, a sewer laid to a depth of over 8 ft. will usually require 3 ins. birds-mouthed sheeting with 8 ins. by 4 ins. walings and Foochow pole struts varying from 6 ins. to 8 ins. diameter according to the width of trench.

In filling in the trench on the completion of the work, the filling should be in about 6 ins. layers and then should be well punned. Failing this, undue settlement is bound to occur and the reinstatement of the road will require carrying out twice in consequence. The additional cost thereby incurred, will be greatly in excess of the small cost of labour used in the thorough ramming of the filling in of the trench.

Foundation.—It should be seen that the trench is as dry as possible before the foundation is laid, as otherwise there is a tendency for the cement or lime that is being used in the mixture to be washed out.

For the heavier pipes, those of 2 ft. 3 ins. by 1 ft. 6 ins. section and larger, a cement concrete foundation will generally be used, laid to a depth of 9 ins. and composed of three parts 1½ ins., three parts ½ in., and two parts Ningpo sand to one part of Portland cement.

For pipes of less section, the foundation will vary according to circumstances. As a general rule, cement concrete laid to a depth of 4 ins. in the above proportion and with a subfoundation of lime concrete laid to a depth of 4 ins. should be used.

For 12 ins. and 9 ins. diameter pipes, laid to a depth of not more than 5 ft., lime concrete laid to a depth of 12 ins. should be used, thoroughly mixed in the proportion of four parts of broken bricks, two parts of Ningpo sand and one part of lime.

The foundation should in all cases be well rammed and the top worked up to an even surface, graded so that the pipes can be embedded in it with very little after adjustment.

Laying the Pipes.—There are three main points to be observed in laying all drain pipes, viz. : that the horizontal alignment is straight from manhole to manhole, that the vertical alignment is true, and that the joints are made both thoroughly watertight and clean.

For the horizontal alignment a stringed line should be used, placed just above the top of the centre of the pipe.

The vertical alignment is checked by means of sight rails and boning rods. The **T** piece of the latter should be not more than 8 ins. wide. Both sight rails and boning rods should be painted, one half white and the other half black so that the sighting will be clear and distinct. The sight rails should be securely fixed, so that no settlement can take place.

For the jointing of the pipes two parts of sand to one part of Portland cement should be used for pipes over 12 ins.

in diameter and one part of cement to one part of sand for pipes 12 ins. and less in diameter, and each joint must be personally passed by the Inspector before filling in is commenced. For pipes 2 ft. 3 ins by 1 ft. 6 ins. in size and larger the cement on the inside of the joints can be cleaned by a coolie entering the pipe and carefully wiping away all projecting cement, before it has had time to set. For the smaller pipes, what is known as a "badger" should be used, this consisting of a ball of cloth or waste, made so as to fit close into the pipe, and attached to a bamboo. As each pipe is laid the badger is worked up and down several times opposite to the new joint and any projecting cement is removed.

All 9 ins. and 12 ins. main drains should be tested by means of the smoke-test apparatus before filling-in is commenced.

Manholes.—These should be placed as far as possible at points where the sewer changes its direction, and also at points where other main drains enter.

On 9 ins. and 12 ins. diameter drains, manholes should in any case be placed not more than 150 ft. apart, but in the larger drains this distance may be increased up to 250 ft.

The construction of the manhole should be carried out in accordance with the standard type shown in the Concrete ware Depôt Stock List for Drainage Work.

It is important that all square or sharp corners shall be rounded off and that a fall of not less than one in four shall be given to the benching, these steps being taken so that the manhole shall be kept easily clean.

Gullies.—These should be laid at a distance of about 100 ft., the channel being graded down towards them as described in the section for kerb and channel. The 6 ins. connection should be laid at a gradient of not less than 1 to 60, and the standard type of junction should be used wherever possible. In laying a new drain the junctions should be laid in the correct position for the gullies, as they will eventually be placed. If it should be necessary to cut into the main drain to make a new connection, a socket should be formed to take the spigot end of the connecting pipe.

All connections must be laid so as to run into the main drain at an angle of not less than 60° so as to incline the discharge into the same direction as that of the main drain.

The gully connection should be laid on a foundation of 4 ins. of cement concrete.

Care should be taken to see that the connection does not project inside the main drain.

Connections.—The rules for the laying of all connections are the same as those for gully connections. All private drain connections to new houses are, as a rule, laid by the Council's Contractor and the work is supervised and passed by the District Inspector.

In carrying out any repairs to existing house connections, at the request of the house owner, it should be remembered that although the connection is laid on the public road, the cost of cleaning and repairs up to the point where it joins the Council's main drain should be debited to the house owner. If, however, the connection should be choked on account of the main drain being out of order the work should be carried out at the Council's expense.

13.—CONSERVANCY OF CREEKS.

It should be borne in mind that the creeks form part of the general drainage system of Shanghai and it is therefore essential that they shall be maintained in as clean and satisfactory a condition as possible.

No general rule can be laid down as to the frequency with which they should be cleaned or dredged, as the conditions affecting conservancy vary with different creeks.

The best time to commence dredging is just after the completion of any spring tide, when the amount of tidal water entering and leaving the creeks is at its minimum and when the work can consequently be carried out under the easiest conditions.

It is of first importance that the work should be carried out so as to ensure a uniform grade to the invert of the creek, and the levels to which the dredging is to be effected should be determined by means of pegs and boning rods. In exceptional cases, where extensive dredging is being carried out on a main creek, the levels will be fixed by the Assistant Engineer. It is essential that the dredging be carefully supervised to ensure that it is carried out uniformly and according to the given grade. Failing this supervision, it will be generally found that the dredging is carried out by means of digging holes in the bed of the creek at irregular intervals. The grass and weeds on the banks of the creeks should be periodically cut, but not pulled up. They materially assist in preventing the sides from falling into the creek. The slopes of the banks should not be less than 1½ horizontal to 1 vertical.

The Inspector should make himself thoroughly acquainted with all the creeks in his district, and in the event of any obstruction in the way of damming up, culverting or bunding work being carried out, he should report immediately to the Assistant Engineer.

With regard to access to properties across creeks adjoining public roads, the following rules generally hold :—

1.—Where a road has been constructed adjoining a previously existing ditch or creek, access to properties should be provided at the owner's expense.

2.—When a ditch or creek has been constructed by the Council along a road, and when it may be regarded as an artificial means of drainage, not less than a 12 ft. wide approach shall be constructed at the Council's expense, the cost of any additional width in the approach to be borne equally by the Council and the owner.

14.—MAINTENANCE OF TIMBER BRIDGES.

It is of the first importance that all timber bridges shall be inspected at short and regular intervals, and that the necessity for any repairs should be reported on without delay to the Assistant Engineer. A thorough examination of all stringers, piles, bearers, braces and decking should accordingly be made once a month, and a visit should also be made to bridges at least once a week to view the general condition of the decking.

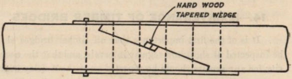
For all members of the structure that are called upon to take any wear and tear, Oregon pine should be used, the adaptability in working, and the immunity of the timber from decay, both comparing favourably with these features in Singapore Hardwoods. For the bridge decking Selangor Batu should be used.

All timber should be treated with two coats of Solignum before being placed in position, and special care should be taken that all joints are thoroughly impregnated with this preservative. The decking should be treated with two coats of Asphaltum and then a blinding of coarse Ningpo sand should be applied.

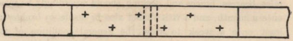
The hand railing should be painted with two coats of white paint.

All repair work should be carried out with all possible dispatch and the labour should, as a general rule, be worked continuously, in shifts, although the rule that no work should be carried out at night should be observed. Only in cases of absolute necessity may a bridge be closed to traffic when repairs are being effected, and in such cases it is necessary that at least two weeks' notice be given, so that due notice may be published in the Municipal Gazette.

When joists in the stringers are made a scarfed joint as shown in the following sketch should be made.



ELEVATION



PLAN

All bolt holes should be bored to a driving fit and all bearings should rest on a layer of tarred felt. Any mortise holes should be treated with some kind of bituminous material to prevent water saturating the timber.

All bolts should have square plate washers ¼ in. thick under head and nut. The dimensions of the sides of washers should be not less than 2½ times the diameter of the bolt. The diameter of the hole for the bolt should not be more than ⅛ in. greater than the diameter of the bolt.

15.—BRICKWORK.

To obtain good brickwork the following points should be attended to :—

1.—The bricks must be sound and well shaped.

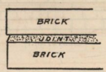
(The bricks supplied by the Contractor for ordinary work are approximately 10 ins. by 5 ins. by 2 ins.)

2.—The mortar should be thoroughly mixed and used stiff. For cement mortar a mixture of three parts of sand to one part of Portland cement should be used and for lime mortar two parts of sand to one part of lime.

3.—A good bond should be preserved throughout the work. Particulars relating to this are given below.

4.—The courses should be kept perfectly horizontal and the arrises plumb.

5.—The joints should all be full of mortar, close, well-flushed up and neatly struck, as sketch.



6.—The bricks should be well soaked in water before being laid.

7.—A damp-proof course of asphalt or tarred felt should be laid in the wall of every building at the level of the underside of the ground floor joists in hollow floors, or level with the underside of the finishing surface in solid floors.

All joints in damp-proofing should be well lapped at least 6 ins. in length.

Bond.

The terms used in respect to this are as follows :—

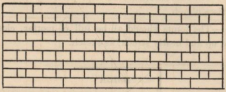
"Headers" are the bricks laid at right angles with the face of the wall.

"Stretchers" are the bricks laid longitudinally with the face of the wall.

"Bats" and "Closers" are bricks broken or shaped to a special size, and inserted in order to maintain a proper bonding.

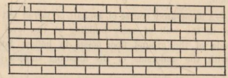
There are two Bonds in general use, known respectively as "English Bond" and "Flemish Bond."

English Bond has alternate stretcher and heading courses as shown in the sketch.

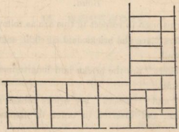


ELEVATION.

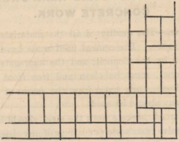
Flemish Bond shows in every course alternate headers and stretchers as shown in the sketches.



ELEVATION.



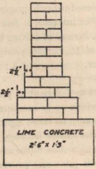
PLAN OF COURSES
2, 4, 6, 8,

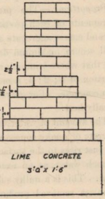


PLAN OF COURSES

1, 3, 6, 7,

The footings and foundations are as shown in the following sketches. The nature of the foundations will vary somewhat, but those shown are for ordinary cases for walls up to a height of 20 feet.





16.—CONCRETE AND REINFORCED CONCRETE WORK.

Materials.—The quality of all the materials is of paramount importance. The cement used must have passed the tests required by the Council, and the aggregate (sand and gravel or stone), must be clean and free from all organic matter and dust. Only water from the mains of the Waterworks Company should be used.

In reinforced concrete work the steel should be free from flaking, excessive rust, scale or coatings of any character which would tend to reduce or destroy the bond.

The size of coarse aggregates to be used depends on the nature of work. Where the concrete has to be placed in narrow forms as in reinforced concrete work, the largest coarse material shall be of such size as will pass through a mesh one inch square measured in the clear and be retained on a mesh ⅛ of an inch square measured in the clear. The size of the largest coarse material may be smaller than the above according to the nature of the work. For mass work it is better to use 1½ ins. chips, mixed with ½ in. chips.

Proportions.—The proportions vary according to the requirements of each particular job. The sand (fine aggregate) and coarse aggregate should be used in such proportions as will secure maximum density. For instance, it has been found that where ½ in. chips are used, instead of mixing in the proportion of 1 ; 2 ; 4, a proportion of 1 ; 2½ ; 3½, produces a denser concrete. For gravel, however, a mixture of 1 ; 2 ; 4, is usually best.

The amount of water used should be sufficient to produce a concrete of quaky consistency, in which upon tamping, the water just rises to the surface. Care must be taken not to use too much water, as an excess of water causes laitance to be formed. This is a milky substance which rises to the surface, and unless removed produces a weak joint and prevents a proper bond in the concrete. Should laitance form, it must be removed after the concrete has partially set.

Mixing.—The mixing of concrete should be thorough, and continue until the mass is uniform in colour and homogeneous. It is preferable to do all mixing by machine.

When hand mixing is necessary, it should be done on a water-tight platform and special precautions taken after the water has been added, to turn all the ingredients together at least six times, and until the mass is homogeneous in appearance and colour.

For machine mixing, the mixing should continue for the minimum time of 1½ minutes after all the materials are in the mixer.

The remixing of mortar or concrete that has partly set should not be permitted.

Placing.—Concrete after the completion of the mixing should be conveyed rapidly to the place of final deposit; under no circumstances should concrete be used that has partly set.

When the placing of concrete is suspended, all necessary grooves in joining future work should be made before the concrete has set. When work is resumed, concrete previously placed should be roughened, cleansed of foreign material and laitance, thoroughly wetted and then slushed with a mortar consisting of one part Portland cement, and not more than two parts of fine aggregate.

The surfaces of concrete exposed to premature drying, and during the hot weather, should be kept covered and wet for a period of at least seven days.

Concrete should not be mixed or deposited at a freezing temperature.

Forms.—Forms or centres should be substantial and unyielding, and be sufficiently tight to prevent leakage of mortar. The proper time for the removal of the forms should be determined by the Assistant Engineer.

Reinforcing.—The reinforcement must be placed exactly as shown on drawings, and must be so held as to maintain its position during the placing of the concrete. Where it is necessary to lap bars, the bars must lap a distance equal at least to forty times the diameter of the bar.

17.—MATERIALS.

Road Materials.

These are divided in to two classes :—

1.—Those supplied by the Council's Quarry at Pingchiao.

2.—Those tendered for annually and supplied by Contractors.

1.—Quarry Materials.

Consist of :—

a.—Quarry spalls—large stone roughly 1 ft. cube.

b.—Unbroken stone—of various sizes.

c.—1½ in. Stone.

d.—1 in. ,,

e.—½ in. ,,

f.—¼ in. ,,

g.—Run of Engine. (A grading midway between ¼ and ½ in. stone).

h.—Decomposed sand.

The sizes of the stone received should from time to time be compared with the samples in the Inspector's Office, and marked difference in size should be reported to the Assistant Engineer.

Tenders are called for annually for the transport of Quarry Materials from the Quarry to Shanghai, at so much per fong.

The Quarry Overseer keeps a record of the quantity and description of the material loaded into each boat and issues the Voucher of which the following is a sample.

No..............

SHANGHAI MUNICIPAL COUNCIL.

PUBLIC WORKS DEPARTMENT.

PING-CHIAO QUARRY.

VOUCHER FOR MATERIALS.

No. of P. W. D. Order.	Measurement at Quarry.	Material.	Date of leaving Quarry.	Date of Arrival in Shanghai	Contractor.	Amount paid for loading.		Remarks.
	Fong					$	cts.	

Measurement in Shanghai:—

....................................*Overseer (at Quarry).*

FONG ....*Inspector (at Shanghai).*

This is enclosed in an envelope printed as below, together with the Contractor's permit :

P. W. Office No.........................

Quarry No......................................

上海工部局

SHANGHAI MUNICIPAL COUNCIL.

Ping-Chiao Quarry,...19........

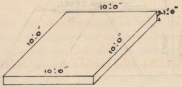
The Envelope is sealed and handed to the boatman, who on arrival at Shanghai hands the envelope and contents to the contractor or his representative who brings it to the Assistant Engineer's office and hands it to the Engineer-in-Charge of the distribution of materials, he initials it and marks on the envelope the Depôt or place at which the materials are to be landed.

The Contractor supplies labour to land material and stack into symetrical heaps on the bank or within 150 yards of the banks of the following :—

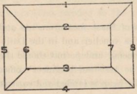
Whangpoo River (within Settlement Limits).
Soochow creek. From mouth to Rubicon Road.
Hongkew creek. ,, ,, to North Szechuen Road Bridge.
Sawginkiang. ,, ,, to Kiangwan Road.
Tsepang. ,, ,, to Burkill Road.
Yangtszepoo creek. ,, ,, to Ward Road.

Due notice must be given the contractor when it is required that material shall be landed on the banks adjoining any shallow section of these creeks.

The unit of measurement of all material is a fong of 100 English cubic feet.



Material should always be stacked in the form of heap as shown below :

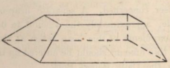


The heaps should be stacked in bays in the yard for reasons which are obvious.

The procedure should be as follows :—

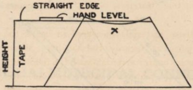
1.—The Inspector must take all measurements personally and not leave it to a foreman.

2.—The Inspector should make a plan of the heap in his note book thus :



This form will in future be printed on the envelopes brought down by the contractor's boats from the Quarry.

and to economise time, should measure the sides in the order given 1, 2, 3, 4 (all the sides) then the ends 5, 6, 7, 8 (all the ends). Then he should take the height in two places, thus :



Taking care to average any hollow places as at X.

As the contractor is under penalty for any delay, materials should be measured as soon as the heap is landed and squared up.

The details of these measurements and the plan should be entered on the voucher and in the Daily Report Book for record. The voucher and permit should then be returned in its envelope to the Assistant Engineer's office within 48 hours from the time the heap is landed and squared up.

In the event of the measured fongage not agreeing with the fongage on the voucher, the Inspector will be notified by the Assistant Engineer concerned and he should at once remeasure the heap; if possible in the presence of the contractor or his representative, and record the second measurement in his Daily Report Book.

Transfer of Materials to other Districts.—This should only be done on receipt of an order from the office, signed by the Assistant Engineer concerned. A separate heap of material should be made, approximately the amount to be transferred and the measurements of this heap taken as the amount transferred and this amount should be entered up in the Labour List and in the Daily Report Book.

Transfer of materials to Contractors and Public Utilities. —The same procedure is to be followed as for transfer to other Districts, but the amount transferred should also be entered in the Private Works Book so that a debit note can be rendered.

Contractors' Materials.—For list see copies of Annual contract.

For those materials measured in heaps the same procedure applies as regards the Quality, Measurement and Transfer as for quarry materials with the following exceptions :

Contractors' materials, when required, are ordered as follows. The Inspector notifies the Assistant Engineer, through the Daily Report Book, of the quantity of material he requires ; at least a week in advance.

The Assistant Engineer concerned makes out an Order on the contractor on one of the official Annual Contract Order Forms. This order is then handed to the contractor by the Assistant Engineer with any verbal instructions that may be necessary.

The clauses in the annual contract for supply of materials governing delivery are as follows :—

> 1.—All materials delivered must be equal in quality, dimensions, and in every other respect to the samples in the office of the Commissioner of Public Works.
>
> 2.—Bricks, lime and paper shall be delivered at the Contractor's expense as required at any property, depôt, building or works under the control of the Council within or about the limits of the Foreign Settlement of Shanghai.
>
> 3.—Sand, granite and broken bricks shall be delivered as required at the Contractor's expense on the banks or within 150 yards of the banks of any navigable creek within or about the limits of the Foreign Settlement of Shanghai and shall be neatly stacked for measuring.
>
> 4.—Until the materials have been measured and accepted the Contractor shall provide and maintain all

barriers, lights and watchmen considered necessary by the Commissioner of Public Works and will be responsible for any damage, loss or accident due to his carelessness or neglect. This liability will cease one week after delivery unless measured before.

6.—In case the Contractor fails to deliver the materials within 21 days of the Commissioner of Public Works' written order or, in the event of the order exceeding 30 fong, at the rate of not less than 30 fong per day on the expiry of such 21st day until the order is fulfilled, the Council shall be at liberty to obtain the material from other sources and the Contractor shall pay any additional cost which may thereby be incurred.

In the event of the Contractor failing to deliver the materials ordered within 21 days of the Commissioner of Public Works' written order, a deduction of 20 per cent. of the schedule rate will be made for each complete week in excess of the 21 days.

7.—In case any material delivered does not, in the opinion of the Commissioner of Public Works, comply with the terms of this Specification the same shall be removed by the Contractor at his own expense within 48 hours of receipt of notice so to do from the Commissioner of Public Works.

If the Contractor shall fail to remove any rejected material after 48 hours notice so to do has been given to him in that behalf, the Council may cause the same to be removed by any other person or persons and the costs and expenses incurred or consequent thereupon shall be paid by the Contractor forthwith or, at the option of the Council, shall be deducted from any moneys then or thereafter due from the Council to the Contractor.

Inspectors must always see that materials supplied by Contractors under the annual contracts are, in quality and size, up to the standard of the samples kept in the Inspector's office.

This is one of the most important of an Inspector's duties, as Contractors are constantly passing off inferior materials. As soon as such irregularity comes to the notice of an Inspector a verbal report should be at once made to the Assistant Engineer concerned, record also being made in the Daily Report Book.

18.—TOOLS, IMPLEMENTS AND PLANT.

It is of the first importance that each Inspector shall regularly and systematically examine all of the above in his district, in the interests both of efficiency and economy in the carrying out of any works.

All repairs required should be forwarded without delay to the Tungchow Road Workshops, accompanied by the necessary signed requisition.

Stock should be taken personally by the Inspector at the end of each month and a return made on the forms supplied for that purpose.

It is almost impossible to give full details of what is required in the way of inspection, and the Inspector must be largely governed by common sense as to when any tool, etc., is in need of repairs or when it should be condemned from any further use. In the latter case, all condemned tools, etc., should be stocked at the end of each month and a report made accordingly to the Assistant Engineer, who will arrange for the sale of the same as scrap.

No new tools should be issued unless the old one is handed in.

All hand rollers, hand-carts and wheelbarrows should be inspected, cleaned and oiled or greased once a week. Blunt pick-axes should be sent at once to the Tungchow Road Workshops to be sharpened, it being a serious waste of time and labour to work with these after they have become blunt. Picks should not be kept in use after the steel tips are so worn that the end is ½ in. square.

Tar Boilers.

When surfacing cannot be carried out owing to bad weather the Asphaltum in the boiler must be drawn off into barrels. When the boiler is sufficiently cool, all the sediment should be removed; if necessary use a scaling hammer. Care must be taken when chipping, not to pierce the shell.

If there be any signs of a cracked or buckled plate the boiler must be sent immediately to Tungchow Road Workshops for repairs.

19.—LABOUR, ETC.

All works coolies will keep the following hours :—

April to October inclusive	6 a.m. to 11.00 a.m.
	1 p.m. to 5.00 p.m.
November to March	7 a.m. to 11.30 a.m.
	1 p.m. to 5.00 p.m.

Artisans commence at 7 a.m. all the year round.

It naturally follows that District Inspectors will keep the same hours as the coolies.

The coolies must be on their work at the above hours, except when they are working at a considerable distance from their work. If this distance exceeds one mile, the District Inspector should use his discretion and make some time allowance for travelling.

The District Inspector must personally supervise the engagement of coolies in the morning, and should make a point of seeing them paid three of four times a week. He must be on the look out for "squeezing" by foremen and take means to prevent it.

Only physically fit men should be employed, and no old men or boys.

Steam rollers, steam wagon and motor trucks will work the same hours, it is therefore necessary that the firemen should attend early in the morning so that there is sufficient steam pressure for the rollers to commence work at the same hour as the coolies.

The hours of the present Stud Contract are :—

May to October inclusive	6 a.m. to 10.30 a.m.
	1 p.m. to 4.30 p.m.
November to April	7 a.m. to 11.00 a.m.
	1 p.m. to 4.30 p.m.

As the hours for ponies are so short, care must be taken te see that a full days work is obtained from them, and mafoos should be watched to see that they do not return to the stables too early.

Foremen will keep the same hours as the coolies. No foreman must be engaged without reference to the office. When an Inspector wishes to fine a foreman, he will note the same in his Daily Report Book. Fines will be in multiples of 10 cents.

When a foreman is sick, the fact must be stated at the foot of the Labour List stating the number of days absent. When he returns to work his number will again be inserted in the "Foremen's" column of the labour list. Foremen will not be paid during sick leave.

Badges will be worn at all times when on duty. Foremen who do not wear their badges should be fined.

Watchmen will be entered on the Labour List and paid weekly on Mondays, the object being to keep a portion of the watchman's pay in hand in case it is necessary to fine him. No coolie who has been employed on day work shall be engaged as a night watchman.

Watchmen should be visited at least once a week to see that they are not asleep, and that lamps are properly placed and alight. All night inspections must be reported in the Inspector's Daily Report Book for entry in the Night Inspection Book.

Sunday work will be avoided whenever the public convenience is not interfered with. If an Inspector wishes to be absent from his work on any day he must obtain permission from the Assistant Engineer-in-Charge of his District.

Rates of Pay.

GRADE.	WHERE EMPLOYED.	PAY.	REMARKS.
Coolie	Parks and Open Spaces.	32 Copper cents daily	Qualified gardeners 38 cents.
do.	Raking mud roads and weeding and cleaning paths.	32	
do.	Street sweeping and cleansing.	32	
do.	General construction and maintenance work.	38	
do.	Concreteware Yard.	35 and 38	At discretion of Assistant Engineer-in-Charge.
do.	Pingchiao Quarry	$0.30	Large money
Watchmen	General	38 Copper cents daily	
Hot Asphalt Workers	Sinza plant on inside work only	44	Only to be paid to men whose work is particularly arduous.
do.	Asphaltic concrete workers.	42	Only to be paid to men working on hot asphaltum most of the day.
Hot Asphalt Workers	Surfacing.	40	
Sewer Trench Workers	Underground Trench Work.	See Remarks Column.	Up to 6 copper cents extra may be paid to coolies employed most of the day on particularly unpleasant and arduous work underground. Only to be issued in exceptional cases.
Brick Layers	General	48	
Chippavers.	do.	48	
Shanghai Carpenters	do.	48	
Ningpo Carpenters.	do.	72	
Stonecutters	do.	60	
Painters	do.	72	
Special Coolies	do.	$3 $2.50	Weekly in Central District. ,, ,, other Districts.
Works and Gully cart Mafoos.	do.	$9.00	Monthly.
Water cart Mafoos	do.	$9.50	Monthly.

No extra pay will be paid to labour on monthly pay sheets for Sunday and holiday work except on China New Year holidays and Dragon Festival. On these days all classes of labour will be paid double pay if at work. The Inspectors must inform the Assistant Engineers, through the Daily Report Books, which men on monthly pay sheets are entitled to this extra pay, whereas the extra pay for daily labour must be shown on labour lists as separate items.

Sunday and holiday work should be distributed as evenly as possible.

The following are the rates to be paid for overtime.

All Coolies (including gangers) 5 cents an hour up to 9 p.m. and 10 cents after 9 p.m.

All artizans 8 cents up to 9 p.m. and 13 cents after 9 p.m.

All foremen and other employés on monthly pay list (except mafoos) 10 cents up to 9 p.m. and 20 cents after 9 p.m.

Overtime for men on daily pay to be entered on labour lists as separate items.

Men on monthly pay sheets working overtime should be reported to Assistant Engineers through Daily Report Books. Their overtime must not be shown on Daily Labour Lists.

20.—CARTS AND HARNESS.

Inspectors should report without delay as soon as any repairs are considered necessary, it being both unecomomical and unsightly to use either a cart or set of harness that is in need of repairs. It is important to see that the tipping gear is holding the body of the cart firmly to the shafts so that there is no jolting. Loose joints and the consequent rubbing of the parts of the cart against each other accelerate wear and increase the ultimate cost of repairs.

Care must be taken that collars and back pads are well stuffed, and that no animal is chafed by any part of the harness.

When repairs are considered necessary, the cart and/or harness should be sent to Tungchow Road Workshops with a Requisition for the necessary repairs.

In reporting carts for repair the numbers of same and the district to which they belong should be stated.

When work permits carts should be kept in the stables on one afternoon in the week and the mafoos will clean their own carts and harness. All carts must be thoroughly washed down. The slide bars to which the backchain is attached, and also the axles must be greased. Before applying new grease, the hubs of the wheels, the axles, and the slide bars of shafts must be cleaned of old grease by scraping with a sharpened piece of hard wood.

The harness should also be dusted every day, and the leather should be well cleaned and dried and then thoroughly oiled with harness oil. Hames and other brass mountings should be polished.

All iron chains and exposed ironwork of carts and harness should be blackened, by means of a composition supplied for that purpose.

The saddle tree, in which the backchain rests, should always be kept slightly greased.

All bits should be wiped dry each day on the return of the ponies to the stables, and thoroughly cleaned and burnished once a week.

21.—MOTOR TRUCKS.

Motor trucks are expensive to buy and costly to operate, and it is only by the closest supervision and personal interest on the part of Inspectors, that motor transport can be made economical.

One of an Inspector's most important duties is to see that satisfactory working results are obtained from the use of motor transport. Quite the most important point is to see that the loading and unloading are completed with despatch.

Observance of the following points will materially assist Inspectors in obtaining good results :

1. Do not overload, as this only damages the springs on the truck and increases the wear on the tyres.

2. The maximum load is marked on the truck, and the average load should be as near this as possible.

3. See that ample labour is available to load and unload with despatch.

4. Two trucks should not be standing on the same job, unless there is sufficient labour on hand to deal with both lorries at once.

5. See that no material is thrown under the wheels or amongst the mechanism.

6. If no work is available for truck, telephone to Assistant Engineer forthwith.

7. So far as possible keep the trucks for long journeys and use carts for short journeys. If the truck is kept standing frequently for loading and unloading, the best results are not obtained.

8. Do not retain truck if it is not working properly. Send it down to Tungchow Road Workshops with a note, or if it is not in running order then telephone to Workshops.

9. Do not load or unload over side panels of trucks if they are removable. Take them out and replace afterwards.

10. As many coolies should be employed loading and unloading as can be conveniently used, in order not to keep truck standing longer than is necessary.

11. Do not run truck over bad roads or ground or over heaps of material.

12. Ascertain how long it takes truck to go one mile, and also how long it takes to load and unload different materials.

13. So far as possible see that drivers do not stand truck in side streets whilst they frequent tea shops.

14. Truck drivers work same hours as coolies—see that they do not leave work too soon—there is a tendency to ease off towards knocking-off time.

15. See that frame and body of truck are properly cleaned, the engine and other mechanism will be attended to at Tungchow Road Workshops.

16. It is important that the Inspectors make themselves acquainted with the weights of all materials carried. Light materials like ashes can be stacked up high.

17. Arrange for load on return journey whenever possible.

18. The trailers should be constantly employed. It will be found that the drivers and foremen are averse to using them, as it is more trouble handling. It is obvious that the use of trailers is economical.

19. When it is necessary to run truck over a kerb or similar projection, bevelled running planks should always be used.

20. No person other than the authorised driver is permitted to drive, and no one should under any consideration be allowed to learn to drive on any of the trucks.

21. Any complaints about the drivers should be forwarded to the Assistant Engineer.

The following Tables are supplied for use of Inspectors :—

Truck Nos.	Tons	Ft. Long		Ft. High		Ft. Wide		Cubic Contents.
		Ft.	*Ins.*	*Ft.*	*Ins.*	*Ft.*	*Ins.*	*Cu. Ft.*
5108	1¼	8	0	1	6	3	6	42
5109	1¼	8	0	1	6	3	6	42
5110	2	9	5	1	3	5	7	65.70
5111	2	9	0	1	3½	5	8	65.82
5112	2	10	6	2	0	3	6	73.5
5113	1½	8	3½	1	3	5	3	54.5
5115	2	11	6	1	6	6	0	103.50
5117	2	9	0	1	8	4	0	60.
5118	2	11	3	2	1	3	9	88.
5119	2	9	0	1	8	4	0	60.
5120	2	9	0	1	8	4	0	60.
5155	3-4	11	0	1	6	6	0	99.
Trailer	3	12	3	1	2	3	5	49.
,,	1½	10	6	1	2½	3	3	41.3

COST TABLE FOR MOTOR TRUCKS.

To find the cost per Ton-mile for moving materials :

1.—Look at table with proper mileage.

2.—Pick out number of trips daily and then on the same line and under columns headed cost per ton-mile for 1¼, 1½, 2, 3, 3½, and 4-ton trucks you will find the price in tael cents it takes to move 1 ton 1 mile.

3.—Trucks should move material for about 20 to 23 Tael cents a ton-mile.

½ Mile Journey

No. of Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
28	40.00	33.33	25.00	23.81	20.40	17.86
27	41.47	34.57	25.92	24.69	21.17	18.52
26	43.09	35.90	26.92	25.64	21.98	19.24
25	44.78	37.33	28.00	26.67	22.86	20.00
24	46.00	38.88	29.17	27.78	23.81	20.84
23	48.68	40.58	30.44	28.99	24.85	21.74
22	50.91	42.43	31.82	30.30	25·98	22.73
21	53.32	44.44	33.33	31.75	27.21	23.81
20	56.00	46.66	35.00	33.33	28.57	25.00

¾ Mile Journey

No. of Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
24	31.11	25.92	19.45	18.52	15.88	13.89
23	32.47	27.05	20.29	19.33	16.56	14.50
22	33.93	28.29	21.21	20.20	17.32	15.15
21	35.55	29.62	22.22	21.16	18.14	15.88
20	37.33	31.11	23.33	22.22	19.05	16.66
19	39.30	32.74	24.56	23.39	20.05	17.55
18	41.47	34.57	25.92	24.69	21.16	18.52
17	43.92	36.59	27.45	26.14	22.41	19.61
16	46.66	38.89	29.17	27.78	23.81	20.84

1 MILE JOURNEY

No. of Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
22	25.46	21.21	15.91	15.15	12.99	11.37
21	26.66	22.22	16.66	15.88	13.61	11.91
20	28.00	23.33	17.50	16.66	14.29	12.50
19	29.47	24.56	18.42	17.55	15.04	13.16
18	31.11	25.92	19.45	18.52	15.88	13.89
17	32.94	27.45	20.59	19.61	16.81	14.71
16	35.00	29.17	21.88	20.84	17.86	15.63
15	37.33	31.11	23.33	22.22	19.05	16.66
14	40.00	33.33	25.00	23.81	20.41	17.86

1½ MILE JOURNEY

No. of Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
18	20.74	17.29	12.96	12.35	10.59	9.26
17	21.96	18.30	13.73	13.07	11.21	9.80
16	23.33	19.45	14.58	13.89	11.91	10.42
15	24.89	20.74	15.56	14.82	12.96	11.11
14	26.66	22.22	16.67	15.88	13.61	11.91
13	28.72	23.93	17.95	17.09	14.66	12.82
12	31.11	25.92	19.45	18.52	15.88	13.89
11	33.93	28.28	21.21	20.20	17.32	15.15
10	37.33	31.11	23.33	22.22	19.05	16.66

2 MILE JOURNEY

No. of Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
16	17.50	14.58	10.94	10.42	8.92	7.82
15	18.67	15.56	11.66	11.11	9.52	8.33
14	20.00	16.67	12.50	11.91	10.20	8.92
13	21.54	17.95	13.46	12.82	10.99	9.61
12	23.33	19.45	14.58	13.89	11.91	10.42
11	25.46	21.21	15.91	15.15	12.99	11.37
10	28.00	23.33	17.50	16.66	14.29	12.50
9	31.11	25.92	19.45	18.52	15.88	13.89
8	35.00	29.17	21.88	20.84	17.86	15.63

2½ Mile Journey

No. of Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
14	16.00	13.33	10.00	9.52	8.63	7.15
13	17.23	14.36	10.77	10.26	8.79	7.69
12	18.66	15.56	11.66	11.11	9.52	8.33
11	20.36	16.97	12.73	12.13	10.39	9.09
10	22.40	18.67	14.00	13.33	11.43	10.00
9	24.89	20.74	15.56	14.81	12.70	11.11
8	28.00	23.33	17.50	16.66	14.29	12.50
7	31.99	26.66	20.00	19.05	16.37	14 29
6	37.33	31.12	23.33	22.22	19.05	16.66

3 Mile Journey

No. . fo Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
12	15.56	12.97	9.73	9.26	7.93	6.95
11	16.97	14.14	10.61	10.10	8.65	7.58
10	18.66	15.56	11.66	11.11	9.52	8.33
9	20.74	17.30	12.96	12.35	10.58	9.26
8	23.33	19.45	14.58	13.89	11.91	10.42
7	26.66	22.22	16.66	15.88	13.60	11.91
6	31.11	25.92	19 45	18.52	15.88	13.89
5	37.33	31.11	23.33	22.22	19.05	16.66
4	46.66	38.88	29.17	27.78	23.81	20.84

3½ Mile Journey

No. of Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
10	16.00	13.33	10.00	9.52	8.16	7.15
9	17.77	14.81	11.11	10.58	9.07	7.93
8	20.00	16.67	12.50	11.91	10.20	8.93
7	22.86	19.05	14.29	13.61	11.66	10.20
6	26.66	22.22	16.66	15.88	13.61	11.91
5	31.99	26.66	20.00	19.05	16.33	14.29
4	40.00	33.33	25.00	23.81	20.40	17.86
3	53.32	44.44	33.33	31.75	27.21	23.81
2	80.00	66.66	50.00	47.62	40.80	35.72

4 MILE JOURNEY

No. of Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
8	17.50	14.58	10.94	10.42	8.93	7.82
7	20.00	16.67	12.50	11.91	10.20	8.93
6	23.33	19.45	14.58	13.89	11.91	10.42
5	28.00	23.33	17.50	16.66	14.29	12.50
4	35.00	29.17	21.88	20.84	17.86	15.63
3	46.66	38.88	29.17	27.78	23.81	20.84
2	70.00	58.33	43.75	41.66	35.72	31.25

4½ MILE JOURNEY

No. of Trips Daily	Cost per ton-mile for trucks fully loaded, in tael cents					
	1¼ ton	1½ ton	2 ton	3 ton	3½ ton	4 ton
6	20.74	17.29	12.96	12.35	10 58	9.26
5	24.89	20.74	15.56	14.82	12.69	11.11
4	31.11	25.92	19.45	18.52	15.88	13.89
3	41.47	34.58	25.92	24.69	21.17	18.52
2	62.22	51.84	38.88	37.04	31.75	27.78

22.—BUDGET HEADINGS.

All work done and materials ordered must be charged to either Ordinary or Extraordinary Expenditure, under the following headings and sub-headings :—

HEADINGS.	SUB-HEADINGS.
Creek and River	Bridges.
,, ...	Bundings.
,, ...	Jetties and Pontoons.
,, ...	Dredging and cleaning creeks.
Drainage	Re-constructing Sewers.
,, ...	Maintenance of Sewers.

HEADINGS	SUB-HEADINGS
Roads, Maintenance of Roads and Footways	Materials.
,, ,,	Tools, renewals and repairs (includes Danger lamps, kerosine oil, etc.)
,, ,,	Boundary stones.
,, ,,	Street nameplates.
,, ,,	Haulage.
,, ,,	Maintenance of carts and harness.
,, ,,	Raking and repairing mud roads.
,, ,,	Roadside railings.
,, ,,	Miscellaneous.
Road, Cleansing and Watering	Tools, renewal and repairs.
,, ,,	Maintenance of carts and harness.
,, ,,	Materials for gritting wood paving.
,, ,,	Miscellaneous.
Lighting	Gas.
Extraordinary Expenditure	Bridges.
,, ,,	Bundings.
,, ,,	Landing stages.
,, ,,	Drainage.
,, ,,	Land.
,, ,,	Buildings.
,, ,,	Roads-Extensions.
,, ,,	Road-Widenings.
Private Works.	

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